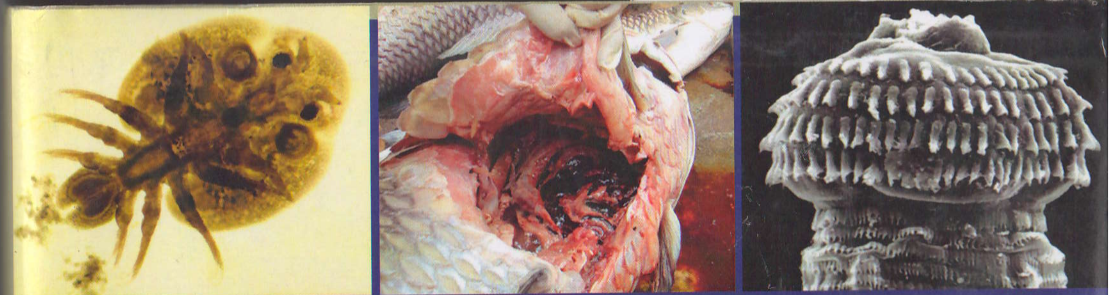

Advances in Fish Disease Diagnosis and Fish Health Management

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Economically Important Shrimp Diseases of India

Subhendu Kumar Otta*, P. Ezhil Praveena, T. Bhuvaneswari and Sherly Tomy

In terms of its contribution to the global food supply and social status, aquaculture has continuously been playing a very significant role. In one way it helps for high profit oriented business to maintain social status and at the same time it also provides cheap source of protein to maintain good health. Fisheries product alone has been responsible to contribute about 16.5% of total animal protein source and 6.5% of total protein consumption (FAO 2012). From the ancient traditional status, the industry has evolved to the present developed form through several scientific interventions and thereby has been able to constantly increase its share in terms of both production and value. While the recent production form the capture fisheries has been in decreasing trend, from aquaculture it is constantly in an increasing trend. Almost 50% of the total fish food for the world population at present is generated from aquaculture practice. The trend is likely to continue and with the depletion of natural stock, aquaculture is expected to overtake as a major fish food supply industry in near future. The situation in India is also having a similar trend where the progress is at a rapid pace. During 2013-14, India's marine product export reached all-time high near to $5000 million.

More than 70% of this share was from frozen shrimp alone and thereby signifying the importance of shrimp aquaculture. Therefore, aquaculture definitely appears to be the only way in augmenting the depleted natural resources of the future.

Rapid expansion of aquaculture practice has got large water body areas added up to the existing ones and thereby bringing change to the natural ecosystem through various interventions. Similarly to coup up with the increasing stocking density, there has been increased use of several inputs including the feedas a major component. The already polluted water from the ponds is either directly or after partial treatment discharged back to the natural ecosystem and again taken back during the subsequent culture practices. Thus the delicately balanced ecosystem is considerably affected bringing severe stress on the animals. Many times, sudden changes in various climatic conditions are added factors to further increase this stress. All these circumstances lead to disease outbreak and thereby the sustainability of aquaculture practice is disturbed.

Disease outbreaks have brought severe losses to shrimp aquaculture industry in India. The loss was more prominent after the adoption of intensification and emergence of viral diseases. The estimated annual loss to shrimp culture industry in India has been predicted to be as high as 300 crores. As per the data obtained from a survey during a particular period, loss of 48717 metric tons of product with a value of 1022.13 crores could be recorded (CIBA Annual report, 2009-10) and this was due to a single most agent such as white spot syndrome virus (WSSV).

In shrimp aquaculture, diseases caused by infectious agents are more prominent than the other factors. All kinds of microorganisms such as virus, bacteria, fungi and parasite have been found to be associated with shrimp and being responsible for different kinds of diseases. During the initial periods only the non-viral diseases were more prominent and found to be not so serious. However, with the progress of intensification, viral diseases became more prominent and severe. As per the most recent information, even the bacterial agents can also be equally dangerous and the severity

could no way be less felt than a viral agent. The emergence of Early Mortality Syndrome (EMS) of shrimp caused by the specific strain of Vibrio parahaemolyticus in many parts of South East Asian countries is the best example.

Viral disease of shrimp in India

More than 20 viruses have so far been reported from shrimp. However, some of these (Box -1 below) have found to be highly virulent and responsible either for mortality or growth reduction, thereby bringing economic loss to the industry. Only 1st two of this listed viruseshave been detected from shrimps cultured in India and the rest so far are considered as exotic.

1. White Spot Syndrome Virus (**WSSV**)- Double stranded DNA virus, OIE listed
2. Infectious Hypodermal and Hemotopoetic Necrosis Virus (**IHHNV**)- Single stranded DNA virus, on the verge of elimination from OIE list
3. TauraSyndrome Virus (**TSV**) - Single stranded RNA virus, OIE listed
4. Yellow Head Virus (**YHV**) - Single stranded RNA virus, OIE listed
5. Infectious MyonecrosisVirus (**IMNV**)- Double stranded RNA virus, OIE listed
6. Covert Mortality Noda Virus (**CMNV**)- Single stranded RNA virus, not listed by OIE

Box 1: Important shrimp viruses responsible for economic loss in different parts of the world

As a single most important agent WSSV was responsible for mass mortality and finally forced for species replacement in India. However, starting from the wide spread tiger shrimp (Penaeus monodon) culture in India, the following viruses (Box II) were considered important to bring economic losses at various capacities.

1. White Spot Syndrome Virus (**WSSV**)
2. Infectious Hypodermal and Hemotopoetic Necrosis Virus (**IHHNV**)
3. Monodon Baculovirus (**MBV**) – Double stranded DNA virus, deleted from OIE list
4. Hepatopancreatic Parvovirus (**HPV**) - Single stranded DNA virus, deleted from OIE

Box II: Important shrimp viruses responsible for economic loss in India.

White Spot Syndrome Virus (WSSV)

Detected first in Penaeusjaponicus during 1992-93, this virus has subsequently been reported inshrimps from different parts of the world. The virus has a wide geographic spread through a wide host range.The name is coined with the presence of typical circular white spots on the carapace and exoskeleton. WSSV is a double stranded DNA virus and the genome size is approximately 300 kb. Different genotypes of this virus with differential virulence properties have been reported. The unique genetic structure of the virus has placed it in an entirely new family, Nimiviridae and genome Whispovirus. This is a highly virulent virus where the mortality starts as early as 3 days after the onset of the disease and mass mortality occurs within 7-10 days. This virus can survive both in water and soil for considerable amount of time without a host. Therefore, it has not been possible to eradicate this virus even with the stringent biosecurity measures. WSSV infection has been responsible for considerable amount of loss in the past and the virus is continuing to do so at present also. Since it is a viral disease, there is no effective treatment to control either in hatchery or farm. However, stocking viral free or SPF stocks combined with pond management can help in preventing the infection. Similarly, use of immunostimulnts and RNAi technology are found to be useful in controlling the disease to some extent.

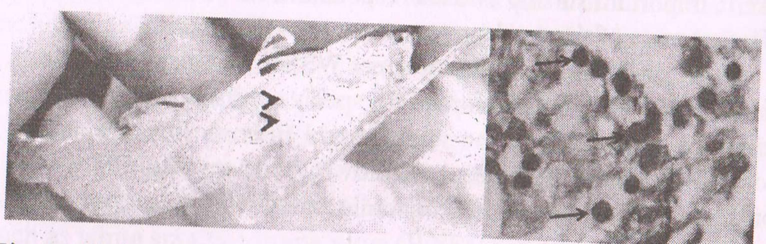

Fig.1: Clinical signs of WSSV infection with white spots on the carapace (Arrow head) and histopathologically multiple basophilic inclusion bodies in the gill (Arrow)

Infectious hypodermal and hematopoietic necrosis virus (IHHNV)

IHHNV is also called as PstDNV (for Penaeusstylirostrisdenso virus). It is the smallest known shrimp virus. This disease was first reported in pacific blue shrimp, Penaeusstylirostris where it was responsible for mass mortality. However, subsequently it has not

shown this virulence to any other penaeid shrimps. Of the three genotypes, Type1, Type 2 and Type 3 only Type 1 and 2 are found to be infectious for shrimp. It causes a chronic disease known as "runt deformity syndrome" (RDS) which is characterized by irregular growth, cuticular deformities and short bent rostra. The principal target organs are gills, cuticular epithelium, all connective tissues, the haematopoeitic tissues, the lymphoid organ, antennal gland and the ventral nerve cord, its branches and its ganglia. Transmission is by horizontal or vertical routes. The prominent histological lesion is the presence of intranuclear, Cowdry type A inclusion bodies, which are eosinophilic and often haloed within chromatin-marginated, hypertrophied nuclei of cells in tissues of ectodermal and mesodermal origin.

Fig.2: Typical clinical sign of IHHNV (thin arrow) and the cowdry type inclusion body (thick arrow) in the gill of Litopenaeusvannamei

The virus is more known for its effect on the growth than mortality. There will be severe size differences among the animals. The FCR will be high and due to body deformity, the value will reduce.

Monodon baculovirus (MBV)

This is a recurring problem in shrimp hatcheries. The causative agent for this disease is Monodon baculovirus or nuclear polyhedrosis virus (PemoNPV). High mortalities are noticed mainly in larvae (protozoea, mysis) and early post larval stages, although the disease may also occur in juvenile and adult. Cumulative mortality among post larvae (PL) may reach over 90% and the disease decreases from PL16 to 25 onwards. As this disease causes sudden onset of mortality in the early life stages, there are few clinical signs like reduced feeding and growth rates, increase in gill and surface fouling.

In severely infected animal the changes noticed are white hepatopancreas and midgut with low hepatopancreatic lipid. Transmission of this disease is by horizontal or vertical mode. MBV forms large, roughly spherical, eosinophilic, polyhedral occlusion bodies (OB's) within the nuclei of hepatopancreatic cells which may occur singularly or in multiples.

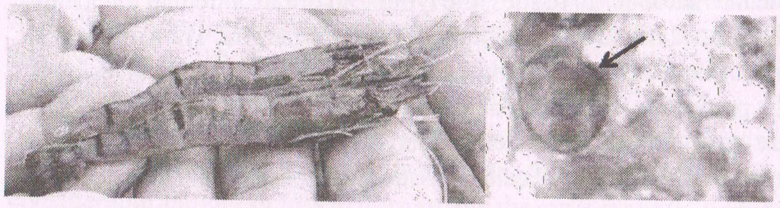

Fig.3: Tiger shrimp infected with MBV and the typical occlusion bodies (Arrow) in the HP

Hepatopancreatic parvovirus (HPV)

This disease was first reported in postlarvae of Penaeuschinensis. All penaeid species are affected and this disease is seen throughout the world. It is found both in wild and cultured shrimps. In cultured shrimp, this disease has been linked to chronic mortalities during the early larval or postlarval stages. It is reported that early juvenile stages are affected more than others and it causes stunted growth. In adult, the outcome of the disease is unknown. Transmission is mainly by horizontal route. It is reported that vertical transmission is unlikely but the eggs may get easily contaminated when it gets the contact of infected material. Digestive gland and midgut caecum are the affected organs. Diagnosis is done by looking for the presence of intranuclear basophilic inclusion bodies which may be ovoid to round in shape in the hepatopancreatic tubular epithelial cells and sometimes adjacent midgut cells of infected animals.

Bacterial diseases of shrimp in India

Shrimp bacterial diseases have not been found to have enough

importantance in farms as these can easily be controlled through water exchange, application of antibiotics, sanitizers or probiotics. However, some of the recently emerged bacterial diseases such as Acute Hepatopancreatic Necrosis Disease (AHPND) of farmed shrimp or zoea syndrome of larvae in hatchery bring severe economic loss to many of the shrimp farms and hatcheries in the world. Some of the important bacterial diseases are listed in the box (Box III) below.

1. Luminiscentvibriosis: Important at hatchery level and farms
2. Zoea syndrome: Important at hatchery level
3. Early Mortality Syndrome (EMS)/Acute Hepatopancreatic Necrosis Disease (AHPND: Important during early stocking period in farms

Box III: Important bacterial disease of shrimp in different parts of the world

Many of the Vibrio sp. are the opportunistic pathogens and they constitute as major bacterial pathogens. Some of the major Vibrios found to be pathogenic to Indian shrimp include V. harveyi that cause luminescent vibriosis. This species is highly virulent to shrimp larvae in hatchery sometimes bringing mass mortality. Other important species include V. parahaemolyticus, V. alginolyticus and V. campbelli. Shrimps infected with vibrios show necrosis of the body part, antenna cut or blisters. During the adverse environmental parameters, there may be mortality in the farms. However, the exact economic loss due to bacterial disease has not yet been estimated from Indian shrimp culture practice.

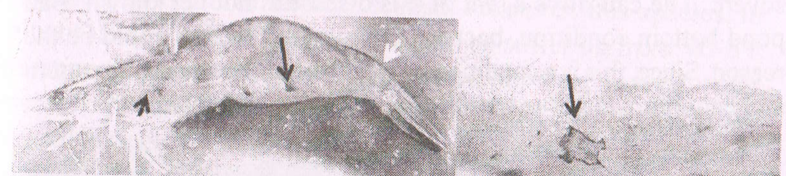

Fig4: Some of the common clinical signs of bacterial infection in shrimp

However, luminescent vibriosis and zoea syndrome are more prominent in many of the Indian shrimp hatcheries. Though the exact cause of the zoea syndrome is not known, bacterial involvement is suspected. In both these disease, conversion of larval stages from one to the next is stopped as the larvae stop feeding.

Emerging diseases in Indian shrimp aquaculture

During the recent times, many types of shrimp diseases have emerged in Indian farms the cause of which are yet to be determined. Many of the farms suffer serious economic losses due to all these diseases.

Running Mortality Syndrome (RMS)

This disease is called so because of the mortality pattern. Farmers observe continuous mortality in certain percentage on daily basis. After 45-50 days of culture, the disease starts as white patches on both sides of the abdomen and subsequently the shrimps face mortality. Towards 90 days of culture, the mortality becomes severe and farmers are forced to harvest the crops. Due to low survivability, the FCR becomes very high and thus the farmers face considerable loss.

Fig.5: Clinical signs of RMS and the shrimp mortality

Black gill disease

In this disease, the gill filaments of both the sides become completely black. Mortality is recorded when the condition becomes severe. The causative agent of this disease is not yet known. Bad pond bottom condition, bacteria or any other factors could be the reason. Since, this is a condition of recent origin, the mortality pattern and economic loss due to this disease is not yet known.

Fig.6: Black gill disease where the gill filaments of both the sides become completely black.

White faeces syndrome

Though this problem was observed long back in many of the South East Asian countries, recently it is being reported from different parts of India. In this, the intestine of the shrimp becomes white and shrimps eject white faecal strings to the pond water. Though some species of Vibrios are suspected to be the reason, this has not yet been confirmed. Though no mortality is observed, farmers complain about the growth reduction.

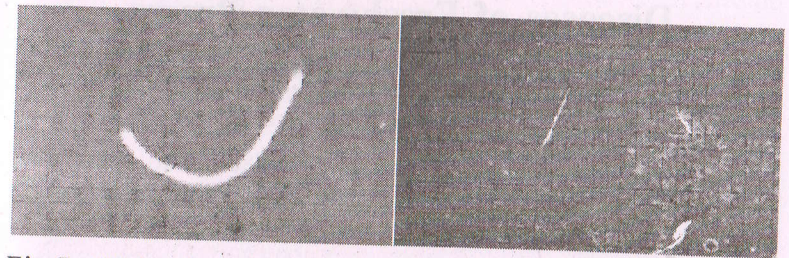

Fig.7: White faecal strings from shrimps with white faeces syndrome.

Conclusion

Indian shrimp farming has been passing through ups and downs and many a times controlled by the disease prevalence. Due to WSSV outbreak it was not possible to continue with the tiger shrimp culture and therefore the exotic species Litopenaeusvannamei was introduced into Indian farming system. However, this species, in spite of its SPF status, is also noticed to be suffering from WSSV infection due to the already contaminated pond and natural water source bodies. Additionally, many other emerging diseases have been noticed for which the farmers continue to suffer loss. Regular disease surveillance progamme combined with the improved biosecurity systems may help to reduce the disease status to great extent. ❑